Problem 1: Curve Fitting

Fit a cubic equation to the following data:

x	3	4	5	7	8	9	11	12
y	1.6	3.6	4.4	3.4	2.2	2.8	3.8	4.6

Along with the coefficients, determine r^2 and $s_{x/y}$

Problem 2: Least Square Regression

Use least-squares regression to fit a straight line to

x	6	7	11	15	17	21	23	29	29	37	39
y	29	21	29	14	21	15	7	7	13	0	3

Along with the slope and the intercept, compute the standard error of the estimate and the correlation coefficient. Plot the data and the regression line. If someone made an additional measurement of $x = 10$, $y = 10$, would you suspect, based on a visual assessment and the standard error, that the measurement was valid or faulty? Justify your conclusion.

Problem 3: Linear Interpolation

Estimate the common logarithm of 10 using linear interpolation.
Interpolate between $log8 = 0.9030900$ and $log12 = 1.0791812$.
Interpolate between $log9 = 0.9542425$ and $log11 = 1.0413927$.
For each of the interpolations, compute the percent relative error based on the true value.

Problem 4:Curve Fitting

Construct P_2 from the data points $(0, -1)$, $(1, -1)$, $(2, 7)$.

Problem 5:Quadratic Interpolation

In the following problems, the values of a function f(x) are given . Find the interpolating polynomial that fits the data. Find the approximation to f(x) at the indicated points.

X	*0*	*1*	*2*	*4*	*5*	*6*
f(x)	*1*	*14*	*15*	*5*	*6*	*19*

Interpolate at x=3.0 and x=5.5

Problem 6: Bisection Method

Find a root of an equation $f(x) = x^3 - x - 1$ using Bisection method

Problem 7: Newton Raphson Method

Find a root of an equation $f(x) = x^3 - x - 1$ using Newton Raphson method

Problem 8: Gauss Elimination

To solve an (nxn) system equations by Gaussian Elimination method using Matlab , for example the system below :

x1 + 2x2 - x3 = 3

2x1 + x2 - 2x3 = 3

-3x1 + x2 + x3 = -6

C = [1 2 -1 ; 2 1 -2 ; -3 1 1]

b= [3 3 -6]

Problem 9:Integration: Trapezoidal Rule

To solve some integrals using trapezoidal rule and a matlab built-in function and to represent the original function in a graph.

$$\int_0^1 \frac{x^2+1}{(x+2)\sqrt{1-2x}}\,dx$$

$$\int_1^\infty \frac{\sin(x)}{x^2}\,dx$$

$$\int_0^1 \int_0^y x^2 y\,dx\,dy$$

Problem 10: Integration: Simpson's 1/3 rule

How to write Matlab code based on the Simpson's 1/3 rule to integrate the function from the data?

Estimate $\int_0^{2.5} f(x)\,dx$ from the data

x	0	0.5	1.0	1.5	2.0	2.5
$f(x)$	1.5000	2.0000	2.0000	1.6364	1.2500	0.9565

Problem 11: Central differentiation

To create plot showing central differentiation using f=sin(pi*x) [-1:1] for different values of n.

Written for n=10 with plot

Problem 12: Forward differentiation

To create plot showing forward differentiation using f=sin(pi*x) [-1:1] for different values of n.

Written for n=10 with plot

Problem 13: Backward differentiation

To create plot showing backward differentiation using f=sin(pi*x) [-1:1] for different values of n.

Written for n=10 with plot

Problem 14: *Gauss-Jordan Method*

Solve the following system of linear equations by using Gauss-Jordan Method:

$$x + y + z = 5$$

$$2x + 3y + 5z = 8$$

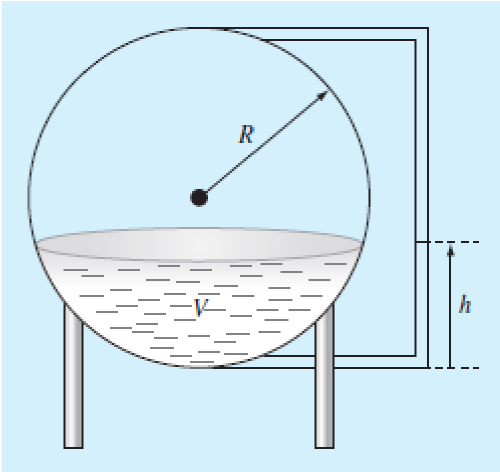
$$4x + 5z = 2$$

Problem 13: Newton Raphson Method

You are designing a spherical tank (Fig. P6.22) to hold water for a small village in a developing country. The volume of liquid it can hold can be computed as

$$V = \pi h^2 \frac{[3R - h]}{3}$$

where V = volume [m3], h = depth of water in tank [m], and R = the tank radius [m].



If R = 3 m, what depth must the tank be filled to so that it holds 30 m3? Use three iterations of the most efficient numerical method possible to determine your answer. Determine the approximate relative error after each iteration. Also, provide justification for your choice of method. Extra information: (a) For bracketing methods, initial guesses of 0 and R will bracket a single root for this example. (b) For open methods, an initial guess of R will always converge.

Problem 14: Newton Raphson method

An oscillating current in an electric circuit is described by

$$\mathbf{I = 9e^{-t}\sin(2\pi t),}$$

where t is in seconds. Determine all values of t such that I = 3.5. Use Newton Raphson method.

Problem 15: ODE45

There are two different basic models for population growth: Exponential model and Logistic model. We will analyse logistic model in this problem. In the logistic model, population of a species is limited by “carrying capacity” of its environment. Mathematically, it is written as:

$$\frac{dN}{dt} = \gamma_0 N \left(1 - \frac{N}{N_{max}}\right)$$

where, N is normalized population, Nmax=100 is the carrying capacity, γ_0=0.05 is the annual population growth-rate, and t is time in years. Use ode45 to solve the following questions

- If the initial population is N=35.5, use ode45 to find the population in 50 years
- If the initial population is N=125, find the population in 100 years

Problem 16: RK-2

Find y(0.2) for $y' = \frac{x - y}{2}$, y(0) = 1, with step length 0.1 using Runge-Kutta 2 method

Problem 17: Euler method

Using the Euler method solve the following differential equation. At x = 0, y = 5.

y' + x/y = 0.

Calculate the Numerical solution using step sizes of .5; .1; and .01

Problem 18: Linear Solver

An amount of Rs.50,000 was invested among three funds: a money-market fund that paid 3% annually, municipal bonds that paid 4% annually, and mutual funds that paid 7% annually. The amount invested in mutual funds was Rs.10,000 more than the amount invested in municipal bonds. The total interest earned during the first year was Rs.2,650. How much was invested in each type of fund?

Problem 19: RK-2

Find y(0.5) for $y' = -2x - y$, y(0) = -1, with step length 0.1 using Runge-Kutta 2 method

Problem 20: Polynomial Regression

Fit a cubic polynomial to the following data

x	3	4	5	7	8	9	11	12
y	1.6	3.6	4.4	3.4	2.2	2.8	3.8	4.6

Along with the coefficients, determine *r 2 and sy/x* .

Problem 21: Differentiation

Find numerical derivative of f(x) = tan−1(x^2/5) at x = 2 using central difference scheme where is x is in radians. Use different values of step size h in central difference scheme and compare with true value of the derivative by plotting error for the different h. f(x) means function of x.

Problem 22: Differentiation

Find numerical derivative of $f(x) = \tan-1(x^3/8)$ at $x = 2$ using forward difference scheme where is x is in radians. Use different values of step size h in central difference scheme and compare with true value of the derivative by plotting error for the different h. f(x) means function of x.